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Trade Secret Protection in a Developing Economy

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Abstract: Surveys of U.S. based multinational enterprises reveal that trade secret misappropriation by current and former employees remains a substantial impediment to conducting business in emerging markets. In this paper, I examine the consequences of strengthening legal protection against this employment related trade secret misappropriation in an open economy context. I develop a general equilibrium model featuring heterogeneous firms that differ in both standard productivity and the degree to which they must expose employees to their trade secrets. To prevent employees from leaking trade secrets, firms offer an incentive compatible wage based on their individual exposure, and the common level of legal protection. Entry selection generates an endogenous distribution of firm specific wages and positive unemployment in equilibrium. Simulations of the calibrated model show that stronger legal protection stimulates multinational investment and increases aggregate productivity. However, these gains are distributed unevenly across workers, and many are worse-off following this reform.

Keywords: Trade secrets, intellectual property rights, multinational firms, development

JEL Classification: F16, F23, O34

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1 Introduction

The Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, implemented by the WTO in 1995, represented a fundamental shift in the international regulation of intellectual property (IP) rights. For the first time, the WTO required all member countries to adhere to strict IP protection standards. The impact of the institutional reforms undertaken by many developing countries in order to meet these standards generated fierce disagreement among policymakers and remains controversial.¹

Increasingly, this debate within the academic literature has centered around the relationship between patent protection in developing countries and the investment incentives of multinational enterprises (MNEs). Recent papers analyzing patent reforms have provided evidence that MNEs expand their involvement in developing countries in response to stronger patent protection (Branstetter et al., 2006, 2011; Canals and Şener, 2014). A complementary theoretical literature, including Lai (1998), Dinopoulos and Segerstrom (2010), Branstetter and Saggi (2011), Gustafsson and Segerstrom (2011), and Klein (2018), has argued that the dynamic benefits of increased foreign investment can, in principle, overcome the costs associated with patent reform. In these models, limiting patent protection allows firms in the developing economy to imitate foreign products, increasing competition and lowering prices. However, weak patent protection also deters investment from foreign firms that internalize the risk of imitation when choosing their production location. Although strengthening patent protection increases monopoly power, the corresponding endogenous increase in MNE investment expands the developing country’s production base, potentially increasing domestic real income.

However, by focusing almost exclusively on patent reforms, the extant literature has largely ignored the impact of changes to the laws governing trade secret protection in developing countries. This is an important omission for several reasons. First, MNEs often choose to rely on secrecy instead of patents to appropriate the returns of their innovations. In recent surveys conducted by the United States International Trade Commission (USITC), U.S. based MNEs ranked trade secrets as the form of IP that is most important to their business operations abroad (USITC, 2010, 2011, 2014). In India, U.S. MNEs reported trade secrets to be “very important” to their business more frequently than patents across *each* of the nine sectors included in the survey (USITC, 2014). In China, survey results indicate that MNEs rely on trade secrets extensively across “almost all industries” and consider trade secret protection to be their foremost IP related concern (USITC, 2010).

Second, WTO standards in trade secret protection are considerably broader than those included for other forms of IP. They require only that members protect undisclosed information that has commercial value, and has been subject to “reasonable steps” to be kept secret.² However, the explicit forms of these protections are unspecified. The ambiguity in member country obligations,

¹See Maskus (2000) for a comprehensive overview of the reforms required by the TRIPS Agreement and the associated policy debate.

²For details see Trade-Related Aspects of Intellectual Property Rights Agreement Article 39 (TRIPS, 1994).

coupled with the absence of guidelines for implementation of protections into national law, effectively leaves the practical level of trade secret protection at the discretion of national governments. As recent discourse illustrates, establishing secure legal protection for trade secrets in emerging markets remains a top policy objective for developed economies (Lippoldt and Schultz, 2014).

Most importantly, the continued limitations of trade secret protection in developing countries have unique implications for the investment and employment practices of MNEs. Firms report that they remain unable to rely on the legal system to enforce contractual language designed to prevent current and former employees from misappropriating trade secrets, such as non-disclosure agreements (NDAs) (USITC, 2011; Sheikh, 2018).³ Without this external enforcement, firms routinely adopt strategies outside of the legal system to safeguard trade secrets from employees. For example, firms may adjust their hierarchical structure so that trade secrets are shared with a minimal number of top level employees (Zabojnik, 2002), or increase production fragmentation to ensure that individual employees have access only to information necessary for their small part of production (Rønde, 2001; Baldwin and Henkel, 2015). In cases where significant disclosure of information to employees is necessary, firms may offer a wage premium to incentivize continued loyalty to the firm (Fosfuri et al., 2001; Rønde, 2001). Indeed, it is well known that MNEs operating in emerging markets tend to pay higher wages and experience lower labor turnover than domestic firms, even after accounting for differences in employee characteristics. As argued by Bernhardt and Dvoracek (2009), there is clear evidence that MNEs offer this wage premium specifically to reduce information leakage through worker mobility.⁴

In this paper, I incorporate this behavior into a novel general equilibrium model to analyze the implications of trade secret protection in developing countries. The basic premise of the model is that a firm’s employees gain imperfect knowledge of the firm’s trade secrets. In order to prevent their employees from leaking trade secrets to competitors, firms must provide a wage sufficient to match the outside value of their employees’ acquired knowledge. Each firm produces a differentiated product variety with heterogenous productivity in exactly the same fashion as in Melitz (2003). In addition, firms differ in the degree to which they must share valuable confidential information with employees. This variation reflects evidence that the nature of some products allows firms to shield most sensitive information from employees, while other products necessitate more complete divulgence.⁵ I refer to this characteristic as the firm’s trade secret “exposure.”

Each firm’s incentive compatible wage is influenced by both its individual exposure and the level of trade secret protection provided by the government. I model this trade secret protection as a hazard rate at which a trade secret leakage attempt by an employee will be prevented by the government. Intuitively, this reflects the likelihood that an employee’s NDA, assumed to be included

³“The most common avenue of misappropriation in China is current or former employees; these employees may take information to new employers or use it to start a rival company, sometimes even despite non-disclosure agreements.” (USITC, 2011)

⁴See Bernhardt and Dvoracek (2009) and Javorcik (2014) for a summary of relevant empirical research.

⁵Surveys of U.S. firms provide direct evidence for variation in trade secret exposure even within narrowly defined industries. For example, among surveyed firms in the pharmaceutical industry, 69.5% of firms indicate that trade secrets are “very important” to their business, 20.6% “somewhat important, and 9.9% “not important” (NSF, 2015)

in all employment contracts, will be enforced. As this rate will influence the expected value of a trade secret leakage, it also influences the wage required to ensure employee loyalty. Naturally, the larger a firm's exposure, the greater the effect of trade secret protection on its incentive compatible wage. In this way, despite the assumption that workers are *ex ante* homogenous, each job carries a firm specific rent and Melitz (2003) style selection effects generate an endogenous distribution of wages and positive unemployment in equilibrium.

In the open economy setting of the model, heterogenous foreign firms may choose to serve the developing home market through either exports or foreign direct investment (FDI) by establishing a horizontal subsidiary. As in Helpman et al. (2004), conducting FDI carries a higher fixed cost than exporting, but allows the firm to avoid trade costs. However, by transferring production and employing workers in the home market, the foreign firm exposes its trade secrets and must pay a wage premium to prevent leakage through the same mechanism as domestic firms. Through its impact on incentive compatible wages, trade secret protection affects the relative attractiveness for foreign firms of serving the home country through exports or FDI.

As in the existing literature examining patent reforms, the endogenous response of MNEs is central to the impact of trade secret protection on domestic real income. However, the model introduces a novel channel through which reform influences real income; its effect on the labor market distortion and associated pecuniary spillovers from wage premiums created by firms' internal efforts to safeguard their IP. In this context, I show that strengthened trade secret protection can result in aggregate welfare gains, coupled with significant distributional effects driven by two distinct channels. First, when protection is strengthened, active firms are able to reduce their wage premium, operate at lower marginal cost, and optimally decrease the price of their varieties. While these price reductions benefit all consumers, the welfare impact of the policy change is heterogenous across workers based on the size of the initial wage premium they enjoyed. Workers at firms with the largest wage premiums, the economy's best jobs, experience the largest downward pressure on their wages and suffer a decrease in their real wage. In contrast, the relatively minor wage premium reduction for workers in the economy's worst jobs are more than offset by price reductions, and these workers enjoy a real wage increase.

Second, the economy experiences substantial product and labor market churning. Under weak trade secret protection, the distribution of active firms in the economy is skewed towards low exposure firms, which enjoy a relatively low marginal cost even when coupled with relatively low productivity. When protection is strengthened, prospective firms have a lower expected marginal cost, and Melitz (2003) selection implies a lower marginal cost threshold for profitable entry into the home market. The marginal costs of low exposure, low productivity firms does not fall enough to meet the now stricter threshold, and they are forced to exit the market. In contrast, relatively high exposure, high productivity firms, previously excluded from the market due to their high wage premium, can now enter the market profitably. The reduction in the requisite wage premium of foreign MNEs implies that more foreign firms will choose to serve the home market through FDI. Although this influx of FDI increases aggregate productivity, the associated reduction in

multinational wage premiums implies an increase to foreign profits at the expense of domestic labor.

Ultimately, the model highlights the heterogenous nature of the effects of strengthened trade secret protection. Product and labor market churning destroys low wage jobs, creates higher wage jobs, decreases prices, stimulates FDI, and increases the average productivity of active firms in the economy. On the other hand, even when reform increases aggregate real income, some workers lose their jobs and others lose a sizable wage premium. Some domestic firms with relatively low trade secret exposure lose an important competitive advantage and are forced out of business. In this way, the model helps to formalize the controversy surrounding trade secret protection in developing countries. Like other policies with significant open economy implications, providing trade secret protection generates complex distributional effects, and costs and benefits that are shared unevenly across both firms and workers.

In addition to the literature analyzing the impact of strengthened intellectual property rights in developing countries, this article is also related to work on the distributional labor market impact of trade related policy. In particular, a series of papers, including Helpman et al. (2010), Davis and Harrigan (2011), and Egger and Kreickemeier (2012, 2013), have developed models featuring firm-wage variation to highlight the heterogeneous effects of international trade and FDI policies. Wage variation in Egger and Kreickemeier (2012, 2013) is driven by profit sharing with workers, which naturally delivers a multinational wage premium, while Helpman et al. (2010) focus on search frictions. Methodologically, my approach is most similar to Davis and Harrigan (2011), in which the wage distribution stems from variation in firm monitoring ability and the corresponding efficiency wages required to elicit employee effort. My analysis offers an alternative source of firm-wage premiums, while remaining consistent with a number of stylized labor market facts in developing countries.

The remainder of this paper is organized as follows: Section 2 introduces the core mechanism of the model in a closed economy setting. Section 3 develops the open economy version of the model. I describe the calibration approach and present simulation results in Section 4. Section 5 concludes.

2 The Closed Economy Model

I assume a fixed supply, $L > 0$, of homogenous workers that are infinitely lived, risk neutral, and supply labor inelastically. All workers discount the future at rate $r > 0$. Workers are hired by heterogenous firms, indexed by i , and earn a firm specific real wage, w_i . Employees are exposed to their firm's production process, and gain imperfect knowledge of their firm's trade secrets. Each firm carries a standard Melitz (2003) productivity, $\phi_i > 0$, and a trade secret exposure, $z_i \in [0, \bar{z}]$. A firm's exposure reflects the value of its employees' trade secret information to outside firms. I assume that all employees are subject to a potentially unenforceable NDA, which prohibits them from disclosing their firm's trade secrets. However, workers have the option to break their contract at any time and leak trade secret information by leaving their original job and beginning

employment at a new firm. To entice workers to leak information, outside firms offer a salary increase to employees based on the value of the information they acquire. Specifically, the exposure of an employee of firm i determines the multiple of her current wage, $w_i(1 + z_i)$, earned as a real flow benefit from leaking.⁶ Employee exposure is common knowledge to employees and firms.

Jobs are lost either when a firm dies at an exogenous rate $\delta > 0$, or in the case of a worker leaking IP, when the government effectively enforces the employee's NDA. Firm death implies that the firm's product has been rendered obsolete, and its trade secrets no longer carry value. Government trade secret enforcement is modeled as an additional rate of job separation for leaking employees, $g > 0$. This g is common knowledge to all firms and workers. Job separation of either type results in unemployment in which workers can no longer benefit from prior trade secret knowledge. I let V_u denote the common expected lifetime value of unemployment. The value of employment (E) at firm i while not leaking (N) and leaking (L) are given by,

$$rV_{Ei}^N = w_i + \delta(V_u - V_{Ei}^N), \quad (2.1)$$

$$rV_{Ei}^L = w_i(1 + z_i) + (\delta + g)(V_u - V_{Ei}^L). \quad (2.2)$$

To keep the analysis tractable, I assume that the profit losses from a trade secret leakage are sufficiently large so that each firm is incentivized to offer a wage that will ensure employee loyalty.⁷ Each firm meets this no-leaking constraint with equality so that

$$V_{Ei}^N = V_{Ei}^L = V_{Ei}. \quad (2.3)$$

Manipulating this constraint provides an expression for the real wage offered by firm i

$$w_i = \frac{rgV_u}{g - z_i(r + \delta)}. \quad (2.4)$$

Since V_u is common across workers, wages differ based solely on firms' exposure. To ensure that all firms pay a positive, finite wage, I assume that exposure is bounded above by $g/(r + \delta)$.⁸ That is,

$$0 \leq \bar{z} < \frac{g}{r + \delta}. \quad (2.5)$$

⁶This multiplicative form of the flow benefit to employee defection follows Davis and Harrigan (2011). As they note, this form implies that the relative ranking of firms by marginal cost is fixed by firm characteristics, so that this ranking is unaffected by the policy change I consider.

⁷This is consistent with the traditional framework in which unprotected intellectual property results in price competition with imitating firms that drive the innovator firm's profits to zero. In this case, heterogeneity in trade secret exposure is interpreted as variation in rival firms' willingness to pay for the confidential information required to imitate the firm's product.

⁸Notice that this requires a strictly positive g . Although this could be avoided by assuming a separate positive rate of leakage failure, this does not affect any results.

This implies that the relative real, and nominal, wages of an two firms a and b is given by

$$\frac{W_a}{W_b} \equiv \frac{w_a/P}{w_b/P} = \frac{g - z_b(r + \delta)}{g - z_a(r + \delta)}, \quad (2.6)$$

where W_i denotes firm i 's nominal wage and P denotes the price index defined below. Of course, since workers at firms with zero trade secret exposure have no valuable trade secret information, they are never offered a salary increase and have no incentive to leak. I normalize the nominal wage of these firms to 1. Imposing this normalization on (2.6) provides an expression for each firm's nominal wage as a function of parameters, trade secret protection, and the firm's exposure,

$$W_i = \frac{g}{g - z_i(r + \delta)}. \quad (2.7)$$

All firms with positive exposure, $z_i > 0$, pay a wage premium $W_i > 1$ over the normalized wage. Moreover, we have

$$\frac{\partial W_i}{\partial z_i} > 0, \quad \frac{\partial W_i}{\partial g} < 0, \quad \frac{\partial^2 W_i}{\partial z_i \partial g} < 0. \quad (2.8)$$

The nominal wage offered by a firm strictly increases in a firm's exposure and strictly decreases in trade secret protection. Furthermore, from the cross partial derivative we see that the higher the exposure, the more sensitive the wage is to trade secret protection. Although (2.7) shows the ranking of firms by wages is invariant to trade secret protection, the magnitude of relative wage differences is very much affected. This crucial aspect of the model implies that the effects of trade secret protection will be heterogenous across both firms and workers, and drives its distributional implications developed below.

2.1 Unemployment

Following the approach in Davis and Harrigan (2011), we can connect the distribution of wage premiums paid to protect trade secrets to the rate of unemployment in the economy. First, from the no-leaking constraint (2.3), and the nominal wage schedule (2.7), we can characterize the cost of job loss at firm i :

$$V_{Ei} - V_u = \frac{1}{P} \cdot \frac{z_i W_i}{g} = \frac{1}{P} \cdot \frac{z_i}{g - z_i(r + \delta)} \geq 0. \quad (2.9)$$

As one would expect, jobs that carry the highest exposure are most valuable to workers since these jobs offer the highest wages. On the other hand, trade secret protection weakens the link between wages and exposure, reducing the value all jobs, but particularly high exposure jobs. Taking the expectation over the endogenous distribution of available jobs in the economy, discussed further in the following section, the average cost of job loss is a function of trade secret protection and the average "exposure distortion" of active jobs,

$$\mathbb{E}V_E - V_u = \frac{1}{P} \frac{\mathbb{E}[zW]}{g}. \quad (2.10)$$

Let $b > 0$ denote the instantaneous probability of re-employment. Assuming the flow benefits to being unemployed are zero, the asset equation for each unemployed worker is $rV_u = b(\mathbb{E}V_E - V_u)$. In a steady state equilibrium, the unemployment rate $u = U/L$ is constant, and the flow into unemployment, must equal the flow out of unemployment. Since all firms pay a wage sufficient to ensure employees do not leak, no job separation stems from government trade secret enforcement in equilibrium. Thus, in equilibrium, we have

$$bU = \delta(L - U) \quad \Rightarrow \quad b = \delta \left(\frac{1 - u}{u} \right). \quad (2.11)$$

Using the expression for rV_u , the wage schedule (2.4), and the normalized nominal wage of $W = 1$ for firms with zero trade secret exposure $z = 0$, the equilibrium unemployment rate is expressed as

$$u = \frac{\delta \mathbb{E}[zW]}{g + \delta \mathbb{E}[zW]}, \quad (2.12)$$

where $0 < u < 1$. The impact of strengthened trade secret protection on the equilibrium unemployment rate depends upon two competing effects. First, note from equation (2.9) that a higher g directly reduces the exposure distortion of all active firms. That is, strengthened external enforcement allows all existing firms to reduce their wage premium and offer wages closer to market clearing levels. On the other hand, recall that changes to g affect the wage required to ensure employee loyalty differently across exposure. In particular, high exposure firms see the largest reduction in their incentive compatible wage. This implies that reallocation of active jobs in the economy through firm entry/exit and expansion/contraction will tend to increase the average exposure distortion. The overall impact of trade secret protection on the unemployment rate depends on relative magnitude of these two competing effects. In general, the direction of change to the unemployment rate is indeterminate and depends on the primitives of the model.

2.2 General Equilibrium

In this section, I embed the labor market mechanism described above into a general equilibrium model of heterogeneous firms a la Melitz (2003). For simplicity, it is standard in these models to assume that firms do not discount the future. In order to be consistent with this assumption, I follow Davis and Harrigan (2011) and focus on the limit case of $r \rightarrow 0$. Although this tends to decrease the incentive to leak trade secrets, it does not fundamentally alter the nature of results.

Preferences over the n available differentiated varieties take a standard CES structure and imply the typical associated price index,

$$U = \left[\int_0^n x(k)^\alpha dk \right]^{\frac{1}{\alpha}}, \quad P = \left(\int_0^n p(k)^{1-\epsilon} dk \right)^{\frac{1}{1-\epsilon}}, \quad \epsilon = \frac{1}{1-\alpha} > 1, \quad (2.13)$$

where ϵ denotes the elasticity of substitution between varieties. Prospective firms hire a fixed amount of labor l_e to develop a new product variety, and learn its (z, ϕ) characteristics. For a given level of trade secret protection in the economy, firms can immediately translate their draw of (z, ϕ)

into a marginal cost. To be notationally consistent with similar models, let γ_i denote the inverse marginal cost of firm i . That is, $\gamma_i = \phi_i/W_i$. Based on their marginal cost information, firms decide whether to hire the required per period amount of labor, l_d , to serve the domestic market. I assume that workers employed in all fixed cost activities do not gain access to the trade secrets of the firm. That is, all fixed cost employment carries $z = 0$, and a nominal wage of $W = 1$. This implies that l_d also represents the fixed cost of the firm, so $l_d = f_d$.

Firms serving the market face a demand given by,

$$q_i = Ap_i^{-\epsilon}, \quad A = \frac{E}{\int_0^n p(k)^{1-\epsilon} dk}, \quad (2.14)$$

where E denotes total expenditure. In the present model, total expenditure is not fixed by the size of the labor force, but is endogenously determined by the total wage income of labor, which depends upon employment and the distribution of wages in equilibrium. Serving the market implies a labor demand equal to $l(z_i, \phi_i) = f_d + q_i/\phi_i$, where q_i/ϕ_i units of labor are exposed to the firm's trade secrets. Profits are given by

$$\pi_i = p_i q_i - W_i \frac{q_i}{\phi_i} - f_d = \left(\frac{1}{\gamma_i}\right)^{1-\epsilon} B - f_d, \quad B = \left[\frac{(1-\alpha)A}{\alpha^{1-\epsilon}}\right], \quad (2.15)$$

after imposing the optimal price of a fixed markup over marginal cost of $p_i = 1/\alpha\gamma_i$. I refer to B as the economy's demand for differentiated varieties. Finally, note that firms never experience profit losses due to trade secret leakage since all firms pay an incentive compatible wage rate in equilibrium. That is, the entire profit impact of imperfect governmental trade secret protection enters the model through firms' use of wages as a private means of safeguarding IP.

Since trade secret protection g and the primitive distribution of (z, ϕ) completely determine the distribution of inverse marginal costs faced by prospective firms, the equilibrium structure of the model is just as in Melitz (2003). Let $h(\gamma)$ and $H(\gamma)$ be the density and cumulative distribution function of marginal costs. The inverse marginal cost threshold, γ^* , governing entry into the domestic market is determined as in Melitz (2003) by the free entry (FE) and zero cutoff productivity (ZCP) conditions. The FE condition equates the average profit from entry to its fixed cost,

$$\bar{\pi}(\gamma^*) = \frac{\delta f_e}{1 - H(\gamma^*)}. \quad (2.16)$$

The ZCP condition ensures that the marginal active firm earns zero profits,

$$\pi(\gamma^*) = \left(\frac{1}{\gamma^*}\right)^{1-\epsilon} B - f_d = 0. \quad (2.17)$$

The marginal cost threshold defined by these two equations implies that firms with marginal cost above the threshold, $\gamma < \gamma^*$ exit the market. This threshold exists and is unique under the same conditions provided in Melitz (2003).

Not only does γ^* determine the employment and profit of each firm, but the resulting density

of active firms, denoted $\mu(i|\gamma^*)$, allows us to calculate the aggregates that characterize the labor market equilibrium. Recall that (2.12) defines the unemployment rate as a function of the average, or expected, exposure distortion across all active jobs in the economy. Since fixed cost activities are assumed to carry zero exposure, the expected exposure of employees of each firm type i must be weighted by the proportion of labor used for production at firm i , denoted $m_i < 1$. Each firm employs q_i/ϕ_i in the production of final goods and shares a common expected employment in fixed cost activities of, $\delta f_e/(1 - H(\gamma^*)) + f_d$. Thus, the average exposure distortion across all active jobs is given by

$$\mathbb{E}[zW] = \int m_i z_i W_i \mu(i|\gamma^*) di, \quad \text{where} \quad m_i = \frac{\frac{q_i}{\phi_i}}{\frac{\delta f_e}{1-H(\gamma^*)} + f_d + \frac{q_i}{\phi_i}}. \quad (2.18)$$

After calculating u from (2.12), we determine the mass of firms, M , by equating total employed labor to labor demand

$$(1 - u)L = M \left[\frac{\delta f_e}{1 - H(\gamma^*)} + f_d + \int \frac{q_i}{\phi_i} \mu(i|\gamma^*) di \right]. \quad (2.19)$$

Finally, M allows us to calculate the price index from (2.13) and national income from total wages. In the closed economy, national income is equivalent to the total revenue received by firms. The wage bill corresponding to firm i 's final goods production is $W_i \cdot q_i/\phi_i = q_i/\gamma_i$. This implies that aggregate expenditure in the closed economy is

$$E = M \left[\frac{\delta f_e}{1 - H(\gamma^*)} + f_d + \int \frac{q_i}{\gamma_i} \mu(i|\gamma^*) di \right]. \quad (2.20)$$

2.3 Strengthening Trade Secret Protection

In this section, I consider the equilibrium reallocation generated from an increase in g in the closed economy framework. When g increases, nominal wages paid by all firms decrease (or remain the same if $z_i = 0$). This shifts the ex ante distribution of γ towards lower marginal cost. More formally, the new distribution H' exhibits first-order stochastic dominance over the original distribution since $H'(\gamma) \leq H(\gamma)$ for all γ . As shown in Falvey et al. (2006) and Demidova (2008), this type of distributional shift in the Melitz (2003) model implies that the demand level B decreases and marginal cost threshold $1/\gamma^*$ decreases. Intuitively, reduced marginal costs imply that average profit increases and, through the FE (2.16) and ZCP (2.17) conditions, adjusted demand must fall in order for the new, lower cost marginal firm to have zero profits from entry.

However, since the impact of g differs across exposure, an increase in g generates substantial reallocation. To see this, first set aside firm entry and exit, and consider how active firms adjust

their output with g .⁹ From (2.14) at the optimal price of $p = \frac{W}{\alpha\phi}$, we have

$$\frac{\partial q_i}{\partial g} = (\alpha\gamma_i)^\epsilon \left[\frac{\partial A}{\partial g} - \epsilon \frac{A}{W_i} \frac{\partial W_i}{\partial g} \right]. \quad (2.21)$$

Focusing on the term in brackets, we see that each firm's change in output is determined by two competing effects. Since B decreases with g , so does A , and the first term captures the effect of this reduced demand on output. Since all firms face the same demand, this effect is common to all firms. On the other hand, the second term including the minus sign, represents the positive effect of reduced wages and hence, reduced marginal cost. Importantly, the relative magnitude of this effect depends upon firm exposure. Firms with zero exposure experience no decrease in marginal cost, and necessarily contract. Firms with a sufficiently high exposure enjoy a large marginal cost decrease and expand production.

Taking a similar look at the change to active firms' profits, we have

$$\frac{\partial \pi_i}{\partial g} = \left[\frac{\partial q_i}{\partial g} \cdot W_i + q_i \left(\frac{\partial W_i}{\partial g} \right) \right] \frac{1}{\phi_i} \left(\frac{1}{\alpha} - 1 \right). \quad (2.22)$$

The change in profits incorporates the forces driving the change in output, while including an additional term that captures the reduction in profits stemming from the decrease in price of the firm's output. This tells us that contracting firms, i.e. those with low exposure, necessarily experience a profit decrease following the strengthening of trade secret protection. Moreover, even if a firm expands production, they may still suffer a profit decrease. Only the highest exposure firms both expand and increase profits.

This mechanism also drives the entry and exit of firms following an increase in g . To formalize this, consider a discrete change to trade secret protection from g_1 to g_2 , with $0 < g_1 < g_2$. Using (2.7), the set of possible exposure and productivity values, (z, ϕ) , for which marginal cost is equal to the marginal cost threshold under g_1 , denoted $1/\gamma_1$, is given by

$$\frac{1}{\gamma_1} = \frac{g_1}{\phi(g_1 - z\delta)}. \quad (2.23)$$

This relationship defines the productivity required to maintain constant marginal cost as an implicit function of exposure, trade secret protection, the associated marginal cost threshold, and the rate of job death. In other words, this implicit function, $\phi_1(z)$, defines the firms that make exactly zero profits under g_1 . Rearranging, we have,

$$\phi_1(z) = \frac{g_1\gamma_1}{g_1 - z\delta}, \quad (2.24)$$

and

$$\frac{\partial \phi_1(z)}{\partial z} > 0, \quad \frac{\partial \phi_1(z)}{\partial g_1} \begin{cases} = 0, & \text{for } z = 0 \\ < 0, & \forall z > 0 \end{cases}, \quad \frac{\partial^2 \phi_1(z)}{\partial z \partial g_1} < 0. \quad (2.25)$$

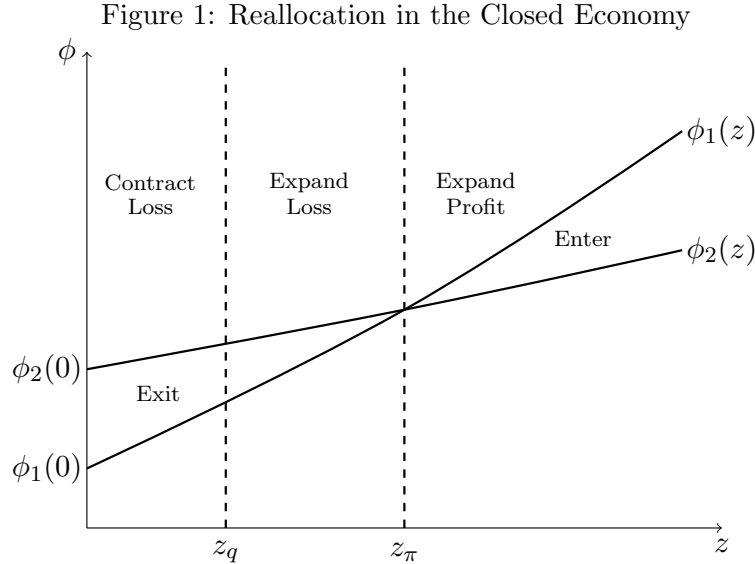
⁹Changes to employment carry the same sign as changes to output.

That is, since wages decrease in g for all firms with positive exposure, the required productivity to achieve marginal cost of $1/\gamma_1$ decreases in g . Moreover, a higher g weakens the relationship between exposure, z , and marginal cost. This implies that, if we plot the function ϕ_1 at the higher g_2 in (z, ϕ) space, it is both everywhere below and *flatter* than ϕ_1 at g_1 .

Of course, the increase in g also implies an increase in the inverse marginal cost threshold to $\gamma_2 > \gamma_1$. For firms with zero exposure, this immediately implies that a higher productivity is required to meet this new threshold. When plotted in (z, ϕ) space, this corresponds to a higher vertical intercept, with $\phi_2(0) > \phi_1(0)$. However, since ϕ_2 is flatter than ϕ_1 , we have the following,

Proposition 1. *There exists an exposure value \hat{z} such that $\phi_2(\hat{z}) = \phi_1(\hat{z})$. Moreover, firms with (z_i, ϕ_i) such that $z_i < \hat{z}$ and $\phi_1(z) < \phi_i < \phi_2(z)$ exit the market, while other firms with $z_i > \hat{z}$ and $\phi_2(z) < \phi_i < \phi_1(z)$ enter the market. In other words, strengthening trade secret protection in a closed economy induces exit of relatively low exposure, low productivity firms and entry of relatively high exposure, high productivity firms.*

Proof: See Appendix.



This reallocation following an increase in g is summarized in Figure 1. The dotted lines represent the exposure levels for which output and profit are constant in g respectively. As discussed above, we have $z_q < z_\pi$, and a portion of firms expand production while still suffering a profit decrease when g increases to g_2 . The solid lines represent the set of (z, ϕ) for which marginal cost is constant, and equal to its associated ZCP under g_1 and g_2 . Although ϕ_2 has a larger vertical intercept, reflecting the increase in the inverse marginal cost cutoff after moving to g_2 , its slope is flatter since the importance of exposure on marginal cost is diminished under a higher g . As shown in the Appendix, the intersection of ϕ_1 and ϕ_2 provides the unique combination of $(\hat{z}, \hat{\phi})$ for which

profit is zero under both g_1 and g_2 . Necessarily, this combination must lie on the constant profit exposure line z_π .

Ultimately, although it is clear that reallocation shifts employment towards high exposure and relatively high productivity firms, important equilibrium effects remain indeterminate in the general setting. For example, recall from (2.7) that the ranking of wages by prospective firms is independent of g , and determined solely by exposure. This implies that the churning towards high exposure firms always destroys some of the economy's worst jobs while creating relatively good jobs. On the other hand, all employees in jobs that remain active after the policy change suffer reduced wages, and it is wages in the economy's best jobs that experience the strongest downward pressure. Additionally, the change to the unemployment rate will depend on the relative magnitude of these churning and wage reduction effects. Unemployment is determined by the average wage premium across active jobs in the economy. Although stronger trade secret protection statically reduces premiums, churning tends to increase the average exposure of employment.

3 Small Open Economy Model

In the small open economy version of the model, domestic firms may serve the foreign market through exports, subject to iceberg trade costs $\tau > 1$, by paying an additional per period fixed cost of $f_x > 0$. As is standard, this generates an additional ZCP condition for domestic exporting firms

$$\frac{1}{\gamma_x^*} = \frac{1}{\tau} \left(\frac{f_x}{B'} \right)^{\frac{1}{1-\epsilon}}. \quad (3.1)$$

Since the domestic economy is small relative to the foreign market, the demand level of the foreign market, denoted B' , is assumed to be exogenous and fixed. I assume parameters are such that only the lowest marginal cost domestic firms choose to export, i.e. $1/\gamma_x^* < 1/\gamma_d^*$.

In addition, foreign firms may serve the domestic market through *either* exports or FDI by paying the associated per period fixed costs, $f'_x, f'_I > 0$. For simplicity, I assume that trade secret protection in the foreign market is perfect, and the exogenous foreign wage is fixed at $W' > 1$. Thus, when exporting, foreign firms do not risk trade secret leakage and their marginal cost is independent of their exposure characteristic, z . When conducting FDI, foreign firms are subject to the same labor market mechanism applied to domestic firms, and pay a firms specific wage W_j based on their exposure. Thus, the profits of a foreign firm from exporting and FDI respectively are given by,

$$\pi'_{x,j} = \left(\frac{W' \cdot \tau}{\phi_j} \right)^{1-\epsilon} B - f'_x, \quad \pi'_{I,j} = \left(\frac{W_j}{\phi_j} \right)^{1-\epsilon} B - f'_I. \quad (3.2)$$

As is standard, I assume that FDI carries a higher fixed cost than exporting, $f'_I > f'_x$. In addition, in order to maintain the selection effects central to Helpman et al. (2004), I impose the following restrictions,

$$\tau W' < \left(\frac{f'_I}{f'_x} \right)^{\frac{1}{\epsilon-1}}, \quad \frac{\tau W'}{W} > 1, \quad (3.3)$$

where \bar{W} denotes the maximum possible wage paid in the developing home market, which necessarily applies to firms with $z = \bar{z}$. From (2.7), this restriction on the maximum wage in the home market implies that the upper bound on exposure in (2.5) must be strengthened to

$$\bar{z} < \frac{g}{\delta} \frac{(\tau W' - 1)}{\tau W'}. \quad (3.4)$$

As discussed further below, the restrictions in (3.3) ensure that, for each level of exposure z , there exist both foreign firms that prefer to export, and firms that prefer FDI. Moreover, for each z , this implies that only the highest productivity firms preform FDI.

Analogous to Helpman et al. (2004), this allows us to write ZCP conditions in terms of export profits and the *additional* profits from conducting FDI. Export profits depend solely on productivity, and we have,

$$\left(\frac{1}{\phi_x^{*f}}\right)^{1-\epsilon} = \frac{f'_x}{B} \left(\frac{1}{\tau W'}\right)^{1-\epsilon}. \quad (3.5)$$

However, the additional profits from FDI depend on the difference between the marginal costs associated with exporting and of producing in the domestic market via FDI. This implies that, rather than a single marginal cost cutoff for FDI, we have a continuum as a function of exposure z . This is represented as the function $\phi'_I(z)$, which is implicitly defined through the zero additional profit from FDI condition,

$$\left(\frac{1}{\phi'_I(z)}\right)^{1-\epsilon} \left[W(z)^{1-\epsilon} - (\tau W')^{1-\epsilon}\right] = \frac{f'_I - f'_x}{B}. \quad (3.6)$$

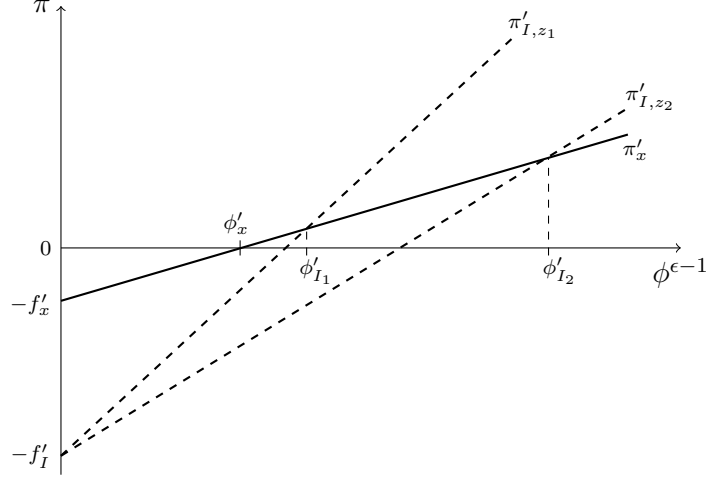
Figure 2 illustrates these relationships by plotting profit from exporting and FDI against adjusted productivity $\phi^{\epsilon-1}$. The solid line depicts π'_x , which from (3.2), is independent of z linear in $\phi^{\epsilon-1}$, with a positive slope determined by market size, trade costs, and the foreign wage. The two dashed lines plot profits from FDI at distinct levels of exposure, with $0 < z_1 < z_2$. Since wages are strictly increasing in exposure, the slope of π'_{I,z_1} is steeper than π'_{I,z_2} at each level of productivity. The inequalities in (3.3) ensure that $\phi'_I(z)$ exists and is unique with $\phi'_x < \phi'_I(z)$ for all z .

3.1 Equilibrium

The labor market functions exactly as described in Section 2, with the exception that the average exposure distortion across active jobs in the economy must account for domestic exporters and FDI. Computing this average requires determining the cutoff associated with each activity and the relative mass of each type of firm. Along with the unchanged condition for domestic firms serving the home market only (2.17), the ZCP condition for domestic exports (3.1), the following modified FE condition provide three equilibrium conditions for domestic firms:

$$\bar{\pi} = p_d(\bar{\pi}_d + \frac{p_x}{p_d} \cdot \bar{\pi}_x) = \delta f_e. \quad (3.7)$$

Figure 2: Export vs FDI in the Home Market



Here, p_d and p_x denote the probability of serving the home market and exporting respectively, which of course depend upon both associated cutoffs, and the primitive distribution of productivity and exposure. The mass of domestic exporting firms relative to those that serve only the domestic market is then, $M_x/M_d = p_x/p_d$.

The relative mass of foreign firms serving the domestic market through exports versus FDI is $M'_x/M'_I = p'_x/p'_I$. These probabilities are determined by (3.5), (3.6), and the primitive distribution of (z, ϕ) for foreign firms. Since the home economy is small, the overall mass of foreign firms is assumed to be unaffected by the home economy. This implies that determining the relative mass of foreign and domestic firms serving the domestic market requires a condition on the scale of exchange between the two countries. Since the present model includes FDI, I augment the typical trade balance condition in Demidova and Rodriguez-Clare (2013) into a current account balance (CAB) equilibrium condition that equates the flow of payments received from abroad to the flow out of the domestic market. The flow of payments to foreign entities is the total revenue received by foreign exporters and firms conducting FDI. The flow of payments into the domestic economy includes both revenue from domestic exports and total wage payments to employees of foreign firms conducting FDI. Thus, the net flow out of the domestic economy due to FDI is equal to aggregate profit of firms conducting FDI, and the equilibrium CAB condition is

$$M'_x \left(\bar{r}'_x + \frac{M'_I}{M'_x} \cdot \bar{\pi}'_I \right) = M_x \cdot \bar{r}_x, \quad (3.8)$$

where \bar{r}_k denotes the average revenue of the associated k type of firm. This allows for the relative mass of all firm types to be determined, and while this naturally imposes a trade surplus for the developing home market, its size is endogenous.

Relative firm masses and the distribution of active firms of each type allow us to fully charac-

terize the open economy equilibrium. Using the density of each category of firms, average exposure distortion is calculated across all active jobs in the home economy as in (2.18). From (2.12), this average determines the unemployment rate, and the mass of firms is determined by equating labor supply and demand. As in (2.20), national income (E) is calculated as the total of all wage payments to domestic labor. Necessarily, this equals the aggregate revenue of firms serving the domestic market: sales of domestic firms in the home market, imports, and sales of FDI firms. However, due to the presence of foreign profits, there is a distinction between national income and GDP in the open economy equilibrium. GDP includes the aggregate value of all goods produced in the domestic market: domestic sales, exports, and sales of FDI firms. Since the CAB condition equates the value of exports to the value of imports and FDI *profits*, $GDP = E + M'_I \cdot \bar{\pi}'_I$. Further details are provided in the Appendix.

3.2 Strengthening Trade Secret Protection in an Open Economy

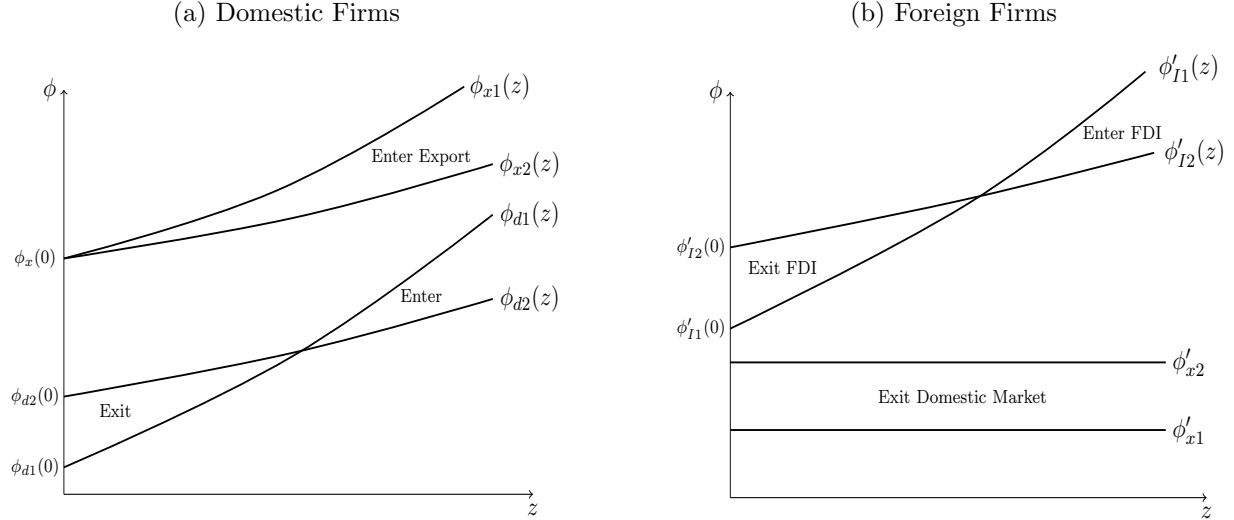
One again, consider the impact of strengthening trade secret protection in the home economy from $0 < g_1 < g_2$. As before, the increase in protection reduces the nominal wages of active firms, and implies that average profit of domestic firms increases. In addition, since the size of the foreign market is fixed at $B' > 0$, (3.1) implies that the marginal cost threshold for exporting, $1/\gamma_x^*$ is also fixed. This directly implies that the probability of exporting p_x increases unambiguously. From the ZCP condition for domestic firms (2.17), and the FE condition (3.7), we see that both the marginal cost threshold for entry into the domestic market $1/\gamma_d^*$ and the domestic demand level B decrease, just as in the closed economy setting.

Next, since the the marginal costs of foreign exporters are unaffected, the decrease in the domestic demand level implies that exporting is less profitable for all foreign firms. Necessarily, this increases the productivity threshold for foreign exports in (3.5), and the least productive foreign firms exit the domestic market entirely. On the other hand, FDI firms do benefit from the stronger trade secret protection, and the benefit is heterogenous across exposure, exactly as for domestic firms. As shown in the Appendix, examining $\pi'_I - \pi'_x$ shows that additional profits from FDI *decrease* following strengthened protection if the change to the marginal cost of producing through FDI is sufficiently small. Intuitively, this is because the decrease in the demand level makes it more difficult to recoup the extra fixed cost required for FDI. However, much like domestic firms, for foreign firms with sufficiently high exposure the reduction in wages in the domestic market increases additional profits from FDI. These findings are summarized in Proposition 2 and Figure 3.

Proposition 2. *Strengthening trade secret protection in a small open economy induces exit of relatively low exposure, low productivity domestic firms, and entry of relatively high exposure, high productivity domestic firms into the domestic market. Domestic firm entry into exporting increases unambiguously. In addition, relatively low exposure, low productivity foreign firms switch from FDI to exports, while relatively high exposure, high productivity foreign firms switch from exports to FDI. The least productive foreign firms exit the domestic market entirely.*

Proof: See Appendix.

Figure 3: Reallocation in an Open Economy



Just as in the closed economy version of the model, strengthening trade secret protection generates considerable reallocation towards higher exposure and higher productivity firms. While the heterogeneous welfare effects discussed in Section 2 remain present, open economy considerations bring additional benefits to the domestic economy. Since the size of the foreign market is fixed at $B' > 0$, not only is there expansion into exporting for domestic firms, but the average revenue of exporters increases. This creates new, relatively high paying jobs. Through the CAB condition, this implies that the increase in exporting is met with some combination of additional imports and FDI. In principle, since there is entry and exit of foreign firms into both exports and FDI, the change to the relative magnitude of these increases is indeterminate in the general setting.

4 Numerical Analysis

In this section, I describe the calibration of the model and present results from the policy experiment of strengthening trade secret protection in the home economy. Since the model is stylized, I do not aim to calibrate the model to a particular country. Instead, I calibrate parameters to capture relevant facts across developing countries, and rely on estimates provided by existing literature where appropriate.¹⁰

¹⁰Computation files are available from the author upon request.

4.1 Calibration

Versions of the Melitz (2003) model have been calibrated extensively using the model’s connection between marginal cost and firm size. Since my model shares this feature, I follow the standard approach and assume that inverse marginal cost (γ) in the domestic market exhibits a Pareto distribution with density $f(\gamma) = \kappa \bar{\gamma}^\kappa \gamma^{-(1+\kappa)}$. However, most leading estimates of the shape parameter (κ) are based on firm size distributions in developed countries, and it is well known that developing countries often display considerably higher dispersion of firm productivity and size (Hsieh and Klenow, 2009; Pagés, 2010). To account for this, I choose the shape parameter to generate dispersion on high end of available evidence and set $\kappa = 2$. The Pareto-Melitz model requires that the elasticity of substitution between product varieties satisfies $\kappa > \epsilon - 1 > 0$. Following Davis and Harrigan (2011), I couple the choice of $\kappa = 2$ with $\epsilon = 2$, and without loss of generality, set $\bar{\gamma} = 0.1$ for numerical reasons. In the main analysis, I assume that the ex ante distribution of marginal costs is common to foreign and domestic firms.¹¹

In the present model, the ex ante distribution of marginal cost is determined by the joint distribution of productivity and wages. The distribution of wages in turn depends upon the initial level of trade secret protection, g_0 , and the ex ante distribution of exposure. To be consistent with a long line of empirical literature, I model the marginal distribution of wages as log normal. I set the distribution’s standard deviation to $\sigma_w = 0.055$ to align with available empirical estimates of the firm-wage component of wage heterogeneity (Abowd et al., 1999; Davis and Harrigan, 2011).¹² With the marginal distribution of wages fixed, g_0 becomes a free parameter, and I back out the implied ex ante marginal distribution of exposure after normalizing $g_0 = 1$.

With these two distributions given, I must specify the distribution of productivity conditional on exposure. Here, I am guided by the important empirical regularity that larger firms tend to pay higher wages, known as the size-wage correlation. To generate a size-wage correlation in line with empirical estimates, a positive ex ante correlation between exposure and productivity is required. In fact, I argue that such a positive correlation is quite natural in the context of the model for several reasons. As mentioned in the introduction, reorganizing production in order to limit trade secret exposure may come at the expense of production efficiency. Indeed, this trade-off is an assumed feature of theoretical examinations of the protection of trade secrets within firms (Rønde, 2001). In this way, we would expect lower exposure firms to tend to exhibit lower productivity. Furthermore, since our interpretation of z includes both the degree of exposure and the value of that exposure to rival firms, it is easy to imagine that exposure to trade secrets at more productive firms carries a higher value. Finally, direct evidence from surveys of U.S. firms show that larger firms tend to attribute greater importance to the use trade secrets in their business model (NSF, 2015). As explained further below, I include the ex ante correlation between productivity and exposure (ρ) in the model’s main calibration in order to match the observed size-wage correlation.

¹¹I explore differences in the marginal cost distribution of domestic and foreign firms in Section 4.3.

¹²Recall that all wage variation in the model is driven by firm characteristics. Abowd et al. (1999) estimate that this firm-wage component accounts for between 12% and 13% of total wage variation.

I target an elasticity between employer size and wages of 0.04 as estimated by Manning (2003). I include results without assuming a positive correlation in Appendix B.

Turning to the remaining parameters of the model, I set $\tau = 1.21$ to reflect the 21% transport cost estimates in Anderson and Van Wincoop (2004), and $\delta = 0.1$ to match available estimates of the annual hazard for firm exit (Corcos et al., 2012). With the ex ante distributions of exposure and productivity given, unemployment and all entry thresholds are determined by fixed cost ratios, relative market size, and relative wages. I set the exogenous foreign nominal wage rate to equal the maximum wage paid in the home economy, $W' = \overline{W}$, which ensures that (3.3) is satisfied. I assume that the fixed cost associated with exporting is symmetric, and without loss of generality, set the fixed cost of entry to $f_e = 10$. However, due to the model's asymmetry, entry thresholds depend upon the endogenous size of the domestic market. Since this implies that the remaining parameter values cannot be backed out directly, I jointly calibrate the size of the foreign market B' and the relative fixed costs of domestic entry (f_d/f_e), exporting (f_x/f_d), and FDI (f_I/f_x) to match relevant moments in developing economies.

First, the overall scale of international trade with the foreign market is determined by both the relative cost of exporting (f_x/f_d), and the size of the foreign market relative to the endogenous size of the domestic market (B'/B). Exploiting the properties of the Pareto distribution of marginal costs, the share (s) of domestic firms that export to the foreign market is $s = \tau^{-\kappa}(B \cdot f_x/B' \cdot f_d)^{\kappa/1-\epsilon}$. For a given s , this relationship expresses relative market size in terms of relative fixed costs. I set this share to $s = 0.142$ based on the World Bank's enterprise survey's finding that 14.2% of firms in Latin America export at least 10% of their sales. Then, I calibrate B' to match the value of exports from the domestic economy as a percent of GDP of 20.3%, which is the 10 year average (2007-2017) across countries in Latin America from the World Bank. To pin down f_I/f_x , I target the average intensity of MNE affiliate sales to all foreign sales (MNE sales + exports) of 34% across the 12 OECD origin countries included in Lankhuizen et al. (2011). Together with the value of exports and the CAB condition, MNE sales intensity determines both MNE sales and imports as a percentage of GDP. Last, I target the 10-year average of the unemployment rate in Latin America of 6.8%, which in concert with other moments, pins down the relative cost of entry in the domestic market (f_d/f_e).

All together, I calibrate five parameters jointly against five moments. The model's calibration performance is summarized in Tables 1 and 2 below. The model is able to match the targeted moments closely, with all model values within 0.5 percent of target. The resulting values of the ex ante correlation between productivity and exposure, foreign market size, and all fixed costs are reported in Table 2.

4.2 Numerical Results

The results from the main numerical simulations are presented in Table 3, Table 4, and Table 5. In these tables, column 1 reports values from the initial calibrated equilibrium, while columns 2 and 3 show results from a 10% (small) and 25% (large) increase in trade secret protection, g .

Table 1: Calibration Targets

Description	Target	Model	Error
MNE sales intensity	0.3400	0.3400	0.00%
Domestic exporter share	0.1420	0.1424	0.28%
Exports % of GDP	20.300	20.321	0.10%
Unemployment rate	6.8000	6.8021	0.03%
Size-wage elasticity	0.0400	0.0400	0.00%

Table 2: Calibration Summary

Pre-set	Description	Value
κ	Marginal cost shape param.	2.0
ϵ	Elasticity of sub.	2.0
σ_w	Std. dev. log wage dist.	0.055
τ	Iceberg trade costs	1.21
δ	Firm death hazard rate	0.1
W'	Foreign Wage	1.539
f_e	Fixed entry cost	10
Calibrated	Description	Value
ρ	Productivity, exposure corr.	0.3110
f_d	Fixed domestic cost	1.0242
f_x	Fixed export cost	2.0646
f_I	Fixed FDI cost	5.5387
B'	Foreign market size	8.2060

All variables are displayed in levels together with their value relative to the initial equilibrium in parentheses. Note that, while all reported changes are monotone in g , the magnitude of the change relative to the change in g decreases for the large reform. That is, the marginal impact of strengthening trade secret protection decreases in the size of the reform. This is a natural consequence of the diminishing marginal effect of g on nominal wages displayed in equation (2.7), and continues to hold for any size of reform. Importantly, since the ex ante distribution of z is backed out after normalizing $g_0 = 1$, this diminishing effect is independent of the choice of normalization.

Strengthened trade secret protection shifts selection pressure away from exposure towards productivity. Consequently, average productivity increases 8.7% and average exposure increases 2% in the large reform case. Despite a reduction in the number of available varieties as firms exit the market due to stricter marginal cost thresholds, reduced marginal costs drive a 6.5% decrease in the aggregate price index. In addition, the reduction in marginal costs enjoyed by surviving domestic firms makes them more competitive in the foreign market. As a result, the value of exports increases by over 1.5% of GDP in the large reform case, a 7.6% increase over its initial level. Through the CAB condition, this directly implies that the value of goods purchased from foreign

firms also increases. However, strengthened trade secret protection makes FDI a more attractive option, and we see a relative shift away from foreign firms serving the domestic market through exports. That is, the value of imports as a percentage of GDP increases only slightly, while MNE sales as a percentage of GDP increases sharply by 42.5% over its initial level. This increase in MNE sales reflects both expansion of existing MNEs, as well as new MNE entrants.

Table 3: Numerical Results

	$g = 1$	$g = 1.1$	$g = 1.25$
Avg. productivity	0.3164	0.3285 (1.038)	0.3440 (1.087)
Avg. exposure	1.5087	1.5230 (1.010)	1.5394 (1.020)
Price index	0.3441	0.3352 (0.974)	0.3250 (0.945)
Active firms	21.524	20.990 (0.975)	20.347 (0.945)
Exports / GDP (%)	20.321	21.057 (1.036)	21.862 (1.076)
Imports / GDP (%)	16.988	17.184 (1.012)	17.311 (1.019)
MNE sales / GDP (%)	8.7513	10.378 (1.186)	12.471 (1.425)

Values in parentheses are relative to initial value with $g = 1$. Simulations use 500,000 draws from the ex ante distribution of productivity and exposure. The size of the domestic labor force is set to $L = 100$.

Table 4: The Role of MNEs

	$g = 1$	$g = 1.1$	$g = 1.25$
MNE wage premium (%)	7.5729	6.4953 (0.858)	5.3407 (0.705)
MNE employees (% of total)	8.1856	9.8067 (1.198)	11.914 (1.456)
MNE labor income	5.8183	7.0066 (1.204)	8.5654 (1.4721)
MNE total profit	3.5779	4.1725 (1.166)	4.9218 (1.376)

Values in parentheses are relative to initial value with $g = 1$. Simulations use 500,000 draws from the ex ante distribution of productivity and exposure. The size of the domestic labor force is set to $L = 100$. Wages, employment and income correspond to production (not fixed cost) activities only.

Indeed, as in existing analyses of strengthened patent protections in developing countries, this increase in FDI represents a critical channel of benefits from stronger trade secret protection. Even though foreign and domestic firms are assumed to share a common marginal cost distribution,

equilibrium selection ensures that MNE activity is concentrated among a small number of firms that exhibit both high productivity and high exposure. Thus, the model emphasizes that FDI benefits the home economy not only through the standard productivity, price index channel, but also by creating jobs that offer large wage premiums to protect their valuable trade secrets. As displayed in Table 4, MNEs pay an average of 7.57% higher wages than domestic firms to ensure employee loyalty at the initial level of trade secret protection. As discussed in Javorcik (2014), this is in line with conservative empirical estimates of the multinational wage premium, after controlling for worker characteristics. Although strengthening trade secret protection reduces this wage premium, the associated expansion in MNE employment implies that overall payments to domestic labor increase 47.2%. Finally, recall that firms with the greatest trade secret exposure experience the largest profit increases when protection is strengthened. This implies that foreign firms have a considerable incentive to encourage trade secret protections in developing countries. As a whole, MNEs see their profits increase 37.6% in the large reform case.

However, closer inspection of the labor market impact of reform, displayed in Table 5, demonstrates that the aggregate benefits from trade secret protection are distributed unevenly among workers. First consider the substantial labor market churning generated by reform. In the large reform case, over 4.5% of existing production jobs are destroyed due to firm contraction and exit. Although these jobs are of low quality (relatively low exposure, low wage), this job destruction still results in a period of involuntary unemployment for these workers, and represents a cost from reform. On the other hand, strengthened protection generates high quality job creation in production as relatively high exposure firms enter and expand. Indeed, these new jobs more than compensate for the jobs lost, and the economy adds a net of over 5% of production jobs over the initial equilibrium.¹³ Moreover, the average exposure associated with these new jobs ranks in the 87th percentile in the distribution of active jobs in the economy. This is good news for initially unemployed workers, who experience an uptick of hiring into quality positions.

Of course, most workers retain their initial jobs, and all workers with positive exposure experience downward pressure on their nominal wage. In aggregate, the economy experiences a substantial 4.3% decrease in average nominal wages. This reduction in wage premiums does have an upside, as unemployment in the model is driven by the distribution of wage premiums above the market clearing level of $W = 1$. As $g \rightarrow \infty$, all wages collapse to 1, and the model reduces to the classic Melitz (2003) model featuring zero aggregate unemployment. In the large reform case, the reduction in wage premiums following an 25% increase in g imply that unemployment decreases sharply by over 1%, a full 18.4% of its initial level. The aggregate change to nominal national income is determined by the competing effects of this expansion in overall employment and the reduction in nominal wages. In the large reform case, the net result is a 0.5% decrease in nominal national income. In real terms however, the decrease in the aggregate price index more than offsets this reduction, and the economy experiences an increase of 1.3% and 5.3% in average real wages and

¹³The economy does experience a net decrease in jobs in fixed cost activities since the relatively low marginal costs of surviving firms implies a greater proportion of total employment in production.

Table 5: Labor Market Effects

	$g = 1$	$g = 1.1$	$g = 1.25$
National Income (nom.)	103.79	103.55 (0.998)	103.23 (0.995)
National Income (real)	301.66	308.89 (1.024)	317.59 (1.053)
Avg. wage (nom.)	1.2458	1.2214 (0.980)	1.1925 (0.957)
Avg. wage (real)	3.6209	3.635 (1.006)	3.6698 (1.013)
Std. log wage (real)	0.0585	0.0530 (0.906)	0.0451 (0.771)
Unemployment (%)	6.8021	6.2135 (0.914)	5.5501 (0.816)
<u>Jobs Lost</u>		2.01%	4.57%
Avg. z (%ile)		10.24	11.08
<u>Jobs Gained</u>		4.34%	9.81%
Avg. z (%ile)		87.28	87.48

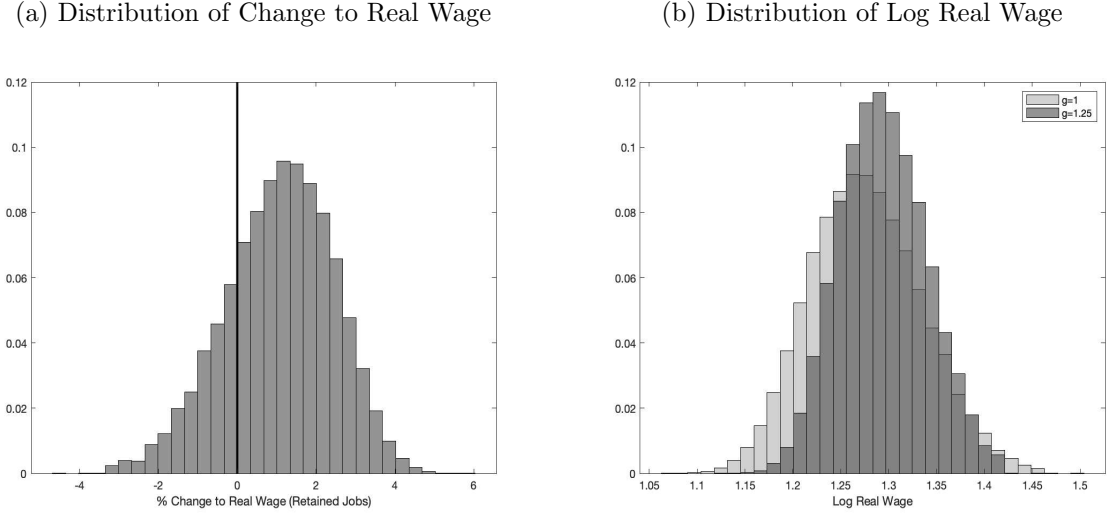
Values in parentheses are relative to initial value with $g = 1$. Simulations use 500,000 draws from the ex ante distribution of productivity and exposure. The size of the domestic labor force is set to $L = 100$. Wages, employment and income correspond to production (not fixed cost) activities only.

real national income respectively.

On an individual level, whether a worker who retains her initial job is made better off from reform will depend upon the relative decrease in her nominal wage, against the economy wide decrease in the price index. The distribution of the percent change to the real wage of workers who retain their original production jobs is illustrated in Figure 4 below. The distribution has a mean of 1.07% and a median of 1.15%, reflecting the average benefit to workers. However, for 21.75% of workers, the decrease in the price index does not fully compensate them for their diminished nominal wage. Necessarily, workers in jobs with high exposure, which enjoyed the largest wage premiums in the economy, experience the largest decrease in their real wage. This includes employees of MNEs, which substantially reduce wages to existing employees despite profit increases. On the other hand, the relative stability of nominal wages in low paying jobs imply that workers who retain these positions are made better off from reform.

Combined with the impact of labor market churning, this effect suggests a considerable reduction in the variation of real wages across jobs. The economy's worst jobs in the initial equilibrium, i.e. those with the lowest exposure and real wage, are either destroyed through contraction and exit, or see an increase in real wage through the price effect. The economy's best jobs experience the largest reduction in wages. Although relatively high exposure jobs are created, stronger trade secret protection implies that these jobs will not match the highest wage premiums offered in the initial

Figure 4: Labor Market Effects



equilibrium. As illustrated in Figure 4, the end result is a reduction in the standard deviation of the distribution of log real wages of 22.9% of its initial value as both tails of the initial distribution are trimmed. When interpreting this result, it is important to keep in mind that the model isolates the firm-wage component of wage variation. Using the estimate that the firm component accounts for about 13% of overall wage variation from Abowd et al. (1999), this result suggests that total variation in log real wages falls by about 3% as a result of a large trade secret reform.

4.3 Greater Foreign Secret Value

In the main numerical analysis, foreign and domestic firms shared common ex ante distributions of exposure and productivity. For many developing countries however, it is more realistic to assume that technology or productivity differences between domestic and foreign firms imply that foreign trade secrets are systematically more valuable. In this section, I analyze numerical results in this alternate case. Specifically, I maintain the same ex ante distributions of domestic firm productivity and exposure as in the main calibration and continue to assume that foreign and domestic firms share a common Pareto distribution of marginal costs in the initial equilibrium (when $g_0 = 1$). However, I calibrate the relative average in the ex ante marginal distribution of exposure in order to target a MNE wage premium of 50% in the initial equilibrium, in line with the high end of estimates considered in Javorcik (2014).¹⁴ In other words, I assume that the average value of foreign trade secrets is sufficiently high so that MNEs must pay an average 50% larger wage than domestic firms in order to prevent leaks. Since foreign and domestic firms still share an initial marginal cost distribution, this necessarily implies that foreign firms draw from an ex ante productivity

¹⁴In the main results, equilibrium selection implied that active MNEs exhibited greater than average exposure and a corresponding MNE wage premium of about 7.5%, despite sharing an ex ante exposure distribution with domestic firms.

distribution with a greater average than domestic firms. Moreover, it implies that strengthening trade secret protection disproportionately benefits foreign firms and generates a relatively larger shift in the foreign marginal cost distribution towards lower costs. I maintain the same values for all pre-set parameters displayed in Table 2, and I recalibrate the remaining parameters to the moments listed in Table 1. Further calibration details and the resulting parameter values can be found in Appendix B.

Table 6: Valuable Foreign Secrets

	$g = 1$	$g = 1.1$	$g = 1.25$
National Income (real)	310.35	319.06 (1.028)	329.13 (1.061)
Avg. wage (real)	3.7474	3.8055 (1.016)	3.8641 (1.031)
Unemployment (%)	6.8131	6.3734 (0.936)	5.8332 (0.856)
Exports / GDP (%)	20.331	20.535 (1.010)	20.594 (1.013)
MNE sales / GDP (%)	8.7796	12.238 (1.394)	16.770 (1.910)
MNE wage premium (%)	49.882	41.888 (0.840)	33.696 (0.676)
MNE labor income	5.8942	8.5598 (1.452)	12.226 (2.074)
MNE total profit	3.5762	4.7984 (1.342)	6.3309 (1.770)
<u>Jobs Lost</u>		3.17%	7.53%
Avg. z (%ile)		8.810	9.297
<u>Jobs Gained</u>		5.55%	13.0%
Avg. z (%ile)		96.41	96.41

Values in parentheses are relative to initial value with $g = 1$. Simulations use 500,000 draws from the ex ante distribution of productivity and exposure. The size of the domestic labor force is set to $L = 100$. Wages, employment and income correspond to production (not fixed cost) activities only.

When foreign trade secrets are substantially more valuable than domestic secrets, the competing welfare effects of strengthening trade secret protection in an open economy context become more pronounced. On the one hand, maintaining weak trade secret protection ensures that foreign firms must pay domestic workers large wages in order to protect their secrets. This not only benefits the workers that are fortunate enough earn these wages, but also allows domestic firms with lower average exposure to remain more competitive in the domestic market despite their productivity disadvantage. On the other hand, strengthening trade secret protection creates a greater average reduction in the marginal costs of MNEs and generates a proportionally greater expansion of MNE

activity in the domestic economy. In the large reform case, MNE sales increase by about 8% of GDP and MNE profits surge 77% as their marginal costs fall sharply. Despite the large reduction in wage premiums, the large uptick in MNE employment represents the creation of high paying jobs, and the net effect is a doubling in total wage payments to MNE workers. In aggregate, this large expansion of MNEs increases the scale of churning in the product and labor markets, driving greater increases in productivity, average real wages, and real national income.

While the benefits of increased FDI are considerable, domestic firms do not fair as well. Since domestic firms experience a relatively smaller decrease in their marginal cost following reform, the expansion of domestic exporting is substantially reduced. In the large reform case, the value of exports increases by about 0.25% of GDP, a fraction of the approximately 1.5% increase in the baseline results. Furthermore, the bulk of contraction and exit is concentrated among domestic firms, and 7.5% of all production jobs are destroyed following a large trade secret reform.

5 Conclusion

Despite the importance of trade secrets to firm behavior and the apparent reluctance of developing countries to strengthen trade secret protections, there remains relatively little research examining the impact of protections in an international context. This paper helps to fill this gap by incorporating trade secret protection into a general equilibrium, small open economy model of international trade. The model features heterogenous firms that differ in both productivity and the degree to which they must expose employees to their trade secrets. This information is valuable to competitors, and firms must offer a wage premium in order to prevent employees from leaking trade secrets. Although workers are ex ante homogenous, variation in exposure coupled with entry selection creates an endogenous distribution of firm specific wages, and positive unemployment in equilibrium. Strengthening trade secret protection shifts selection pressure away from exposure and towards productivity. Low exposure firms lose a competitive advantage and contract or exit the market entirely, while relatively high productivity firms with high exposure can enter the market profitably.

In this context, the model predicts that strengthened trade secret protection is associated with substantial aggregate benefits, coupled with meaningful distributional effects. Stronger protection increases average productivity, lowers prices, and increases real national income. Domestic firms are more competitive in the foreign market leading to increased exporting, the relative safety of sensitive information stimulates multinational investment. Unemployment falls with the decrease in wage premiums, and churning in the product and labor markets destroys relatively low paying jobs, while creating high paying jobs. On the other hand, workers that retain their initial jobs experience downward pressure on their wage. For a substantial portion of workers, the decrease in prices is insufficient to offset the decrease in wages, resulting in a reduced real wage. Moreover, the employees of firms that initially offered the highest wage premiums, and thus the firms that benefit most from the reform, suffer the greatest reduction in wages. There are winners and losers

from reform across both firms and workers, and the interests of a firm and its employees are often in direct conflict.

By highlighting the distributional effects of trade secret reform, the model helps to formalize the controversy surrounding trade secret policy in developing countries. On the other hand, the model emphasizes a particular mechanism through which imperfect trade secret protection influences economic outcomes; employee related misappropriation and its impact on firm investment and employment. Although evidence suggests that this channel is of significant economic importance, the model does not feature all aspects of trade secret protection that are likely important to policymakers in developing countries. In particular, the model does not incorporate technology spillovers across firms, focusing instead on the related pecuniary spillovers from firm efforts to prevent information leakage. Still, the model cannot address issues specific to technology spillovers or the policy implications of the possible reduction in these spillovers if trade secret protections are strengthened. In addition, the model does not directly consider the mechanism by which protections would be enforced, nor any of the associated costs. Hopefully, future research can build on the framework developed in this paper in order to facilitate a fuller understanding of the economic implications of trade secret protection in developing countries.

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Appendix A

A.1 Closed Economy - Proof of Proposition 1

Calculations for iso-marginal cost line:

$$\phi = \gamma \left[\frac{g}{g - z\delta} \right]. \quad (\text{A.1})$$

For a fixed threshold γ ,

$$\frac{\partial \phi}{\partial z} = \gamma \left[\frac{\delta g}{(g - z\delta)^2} \right] > 0, \quad \frac{\partial \phi}{\partial g} = \gamma \left[\frac{-\delta z}{(g - z\delta)^2} \right] \leq 0. \quad (\text{A.2})$$

Finally,

$$\frac{\partial^2 \phi}{\partial z \partial g} = -\gamma \delta \left[\frac{g + z\delta}{(g - z\delta)^3} \right] < 0. \quad (\text{A.3})$$

To prove Proposition 1, we must show the existence of single crossing of $\phi_1(z)$ and $\phi_2(z)$. This amounts to showing that there exists a unique \hat{z} such that $\phi_1(\hat{z}) = \phi_2(\hat{z})$. When $\phi_1(\hat{z}) = \phi_2(\hat{z})$, we have

$$\gamma_1 \left[\frac{g_1}{g_1 - \hat{z}\delta} \right] = \gamma_2 \left[\frac{g_2}{g_2 - \hat{z}\delta} \right]. \quad (\text{A.4})$$

Rearranging yields

$$\hat{z} = \frac{g_1}{\delta} \cdot \frac{g_2(\gamma_2 - \gamma_1)}{\gamma_2 g_2 - \gamma_1 g_1} > 0, \quad (\text{A.5})$$

as $\gamma_2 > \gamma_1$ and $g_2 > g_1$. This \hat{z} exists, as it is necessarily less than the upper bound in (2.5) of $z < g_1/\delta$. By construction, $(\hat{z}, \phi(\hat{z}))$ are the unique exposure, productivity pair such that profit is exactly zero under g_1 and g_2 . Therefore, all firms with (z_i, ϕ_i) such that $z_i < \hat{z}$ and $\phi_1(z) < \phi_i < \phi_2(z)$ exit the market, and all firms with $z_i > \hat{z}$ and $\phi_2(z) < \phi_i < \phi_1(z)$ enter the market.

A.2 Open Economy Equilibrium

In this section, I provide expressions for the endogenous variables that characterize the open economy equilibrium as discussed in Section 3.1. Rearranging the CAB condition,

$$\frac{M_x}{M_I'} = \frac{M_x' \bar{r}_x'}{M_I' \bar{r}_x} + \frac{\bar{\pi}_I'}{\bar{r}_x}. \quad (\text{A.6})$$

Since $M_x'/M_I' = p_x'/p_I'$ and $M_x/M_d = p_x/p_d$ are given by the associated productivity/exposure cutoffs, the CAB condition allows us to calculate the relative mass of all firm types.

As in equation (2.18), I calculate the average exposure distortion as a weighted average across all production jobs, taking into account the proportion of employment in fixed cost activities. The

average exposure distortion of each type of domestic employer by category of sales is given by

$$\mathbb{E}_d[zW] = \int m_{d,i} z_i W_i \mu(i|\gamma_d^*) di, \quad \mathbb{E}_x[zW] = \int m_{x,i} z_i W_i \mu(i|\gamma_x^*) di, \quad \mathbb{E}_I[zW] = \int m_{I,j} z_j W_j \mu'(j|\gamma_I^*) dj, \quad (\text{A.7})$$

where

$$m_{d,i} = \frac{\frac{q_i}{\phi_i}}{\frac{\delta f_e}{1-H(\gamma^*)} + f_d + \frac{q_i}{\phi_i}}, \quad m_{x,i} = \frac{\frac{\tau q'_i}{\phi_i}}{f_x + \frac{\tau q'_i}{\phi_i}}, \quad m_{I,j} = \frac{\frac{q_j}{\phi_j}}{f_I + \frac{q_j}{\phi_j}} \quad (\text{A.8})$$

The overall average exposure distortion is given by,

$$\mathbb{E}[zW] = \frac{M_d}{M_d + M'_I} \left(\mathbb{E}_d[zW] + \frac{M_x}{M_d} \cdot \mathbb{E}_x[zW] \right) + \frac{M'_I}{M_d + M'_I} \cdot \mathbb{E}_I[zW], \quad (\text{A.9})$$

where $M_d + M'_I$ is the total mass of employers in the domestic market. After using $\mathbb{E}[zW]$ to calculate the unemployment rate according to (2.12), the mass of active employers in the domestic economy is derived by equating labor supply and demand.

Denote the average labor used in production of each type of domestic employer by category k of sales as \bar{l}_k . We have,

$$\bar{l}_d = \int \frac{q_i}{\phi_i} \mu(i|\gamma_d^*) di, \quad \bar{l}_x = \int \frac{\tau q'_i}{\phi_i} \mu(i|\gamma_x^*) di, \quad \bar{l}_I = \int \frac{q_j}{\phi_j} \mu'(j|\gamma_I^*) dj. \quad (\text{A.10})$$

The corresponding weighted average domestic labor employed in production is

$$\tilde{l}_p = \frac{M_d}{M_d + M'_I} \left(\bar{l}_d + \frac{M_x}{M_d} \cdot \bar{l}_x \right) + \frac{M'_I}{M_d + M'_I} \cdot \bar{l}_I, \quad (\text{A.11})$$

Letting \tilde{l}_{fc} denote the weighted average domestic employment in fixed cost activities, we have

$$\tilde{l}_{fc} \equiv \frac{M_d}{M_d + M'_I} \left(\frac{\delta f_e}{1-H(\gamma^*)} + f_d + \frac{M_x}{M_d} \cdot f_x \right) + \frac{M'_I}{M_d + M'_I} \cdot f'_I. \quad (\text{A.12})$$

The mass of active employers in the domestic economy is given by

$$(1-u)L = (M_d + M'_I)(\tilde{l}_{fc} + \tilde{l}_p). \quad (\text{A.13})$$

Together with the relative mass of all firm types, this allows us to back out the number of active firms of each type.

Finally, national income equals total wage payments to domestic labor. Since all wages in fixed cost activities are equal to 1, we have

$$E = (M_d + M'_I)\tilde{l}_{fc} + M_d \left(\int \frac{q_i}{\gamma_i} \mu(i|\gamma_d^*) di + \frac{M_x}{M_d} \int \frac{\tau q'_i}{\gamma_i} \mu(i|\gamma_x^*) di \right) + M'_I \int \frac{q_i}{\gamma_i} \mu'(i|\gamma_I^*) di. \quad (\text{A.14})$$

Since all income is spent on the consumption of differentiated varieties, we have

$$E = M_d \cdot \bar{r}_d + M'_x \cdot \bar{r}'_x + M'_I \cdot \bar{r}'_I. \quad (\text{A.15})$$

In contrast, GDP includes the value of all domestically produced varieties:

$$GDP = M_d \cdot \bar{r}_d + M_x \cdot \bar{r}_x + M'_I \cdot \bar{r}'_I. \quad (\text{A.16})$$

Thus, $GDP = E + M_x \cdot \bar{r}_x - M'_x \cdot \bar{r}'_x$, and the final expression in the main text obtains after imposing the CAB condition.

A.3 Trade Secret Protection in the Open Economy - Proof of Proposition 2

To complete the proof of Proposition 2, we must show that relatively low exposure, low productivity firms switch from FDI to exports and relatively high exposure, high productivity firms switch from exports to FDI following an increase in g . Once again this amounts to showing a single crossing of the associated cut-off functions, $\phi'_{I1}(z)$ and $\phi'_{I2}(z)$ defined as the set of (z, ϕ) such that additional profit from FDI is zero for any given $g_1 < g_2$. Consider a firm with $\phi'_{I1}(0)$. We have

$$\frac{B_1}{\phi'_{I1}(0)^{1-\epsilon}} \left[1 - (W'\tau)^{1-\epsilon} \right] - (f'_I - f'_x) = 0. \quad (\text{A.17})$$

By the assumption in (3.3), the bracketed term is positive, and is constant in g . Thus, the fall in demand $B_2 < B_1$ necessarily implies that additional profits from FDI become negative for this firm. That is, $\phi'_{I1}(0) < \phi'_{I2}(0)$. Next, recall that π'_x always decreases with g , and does not depend on z . Thus, if we show that there exists an exposure level for which π'_I does *not* decrease in g , the additional profits from FDI necessarily increase for this firm. We have,

$$\frac{\partial \pi'_I}{\partial g} = \left[\frac{\epsilon - 1}{\gamma} \frac{\partial \gamma}{\partial g} B + \frac{\partial B}{\partial g} \right] \left(\frac{1}{\gamma} \right)^{1-\epsilon}. \quad (\text{A.18})$$

The first term in brackets is positive for firms with $z > 0$, and increasing in z . The second term is negative, and constant in z . Substituting for γ and rearranging, we have

$$\frac{\partial \pi'_I}{\partial g} \geq 0 \quad \text{iff} \quad z \geq \frac{g}{\delta} \cdot \frac{\tilde{B}}{\tilde{B} + 1}, \quad \text{where} \quad \tilde{B} = \frac{-\partial B}{\partial g} \frac{g}{(\epsilon - 1)B}. \quad (\text{A.19})$$

As long as this exposure threshold is below the upper bound imposed in (3.4), which is guaranteed for a sufficiently high value of $\tau W'$, some firms experience an increase in additional profits from FDI following an increase in g . In other words, there exists a \tilde{z} such that $\phi'_{I2}(\tilde{z}) < \phi'_{I1}(\tilde{z})$. Single crossing obtains since $\phi'_{I1}(z)$ and $\phi'_{I2}(z)$ are strictly upward sloping in (z, ϕ) space.

Appendix B

B.1 Independent Productivity and Exposure Distributions

In this section, I examine numerical results when the ex ante distributions of productivity and exposure are independent. Note that this implies an increase in the correlation between marginal cost and exposure relative to the main specification with $\rho > 0$. Thus, selection on marginal cost will generate a lower average exposure in the economy in the initial equilibrium. To maintain the average exposure of the initial equilibrium of the main specification, I set the mean of the ex ante distribution of wages equal to 117% of the mean in the initial specification. The standard deviation is held constant at $\sigma_w = 0.055$. Table B.3 displays calibration results.

Table B.1: Calibration Summary ($\rho = 0$)

Description	Parameter	Value	
Fixed domestic cost	f_d	1.134	
Fixed export cost	f_x	2.310	
Fixed FDI cost	f_I	7.384	
Foreign market size	B'	8.716	
Description	Target	Model	Error
MNE sales intensity	0.340	0.340	0.0%
Domestic exporter share	0.142	0.142	0.0%
Exports % of GDP	20.30	20.45	0.7%
Unemployment rate	6.800	6.785	0.2%

Numerical results are presented in Table B.2. While strengthening trade secret protection still generates the same pattern of benefits for the developing economy, the magnitude of these benefits is notably dampened. Although equilibrium selection implies that MNEs remain more productive than domestic firms, this no longer implies that they exhibit greater than average trade secret exposure. Not only does this imply that MNEs no longer offer a positive wage premium, but also that MNEs experience relatively smaller benefits from reform. Consequently, MNE sales, profits, and wage payments all increase by substantially less than the baseline results. On the other hand, the same product and labor market churning mechanism continues to drive a net addition of production jobs, an increase in average real wages, and a reduction in unemployment as nominal wage premiums fall. The scope of this churning is simply reduced since the combinations of low exposure, low productivity firms and high exposure, high productivity firms is less common. Nevertheless, reduced marginal costs still generate a decrease in the aggregate price index, an increase in real national income, and an expansion in exports as domestic firms become more competitive in the foreign market.

Table B.2: Independent Productivity and Exposure ($\rho = 0$)

	$g = 1$	$g = 1.1$	$g = 1.25$
National Income (real)	279.45	285.54 (1.022)	292.91 (1.048)
Avg. wage (real)	3.3026	3.3190 (1.005)	3.3387 (1.011)
Unemployment (%)	6.7852	6.1671 (0.909)	5.4264 (0.880)
Exports / GDP (%)	20.448	21.041 (1.029)	21.725 (1.063)
MNE sales / GDP (%)	8.8457	9.7634 (1.104)	11.011 (1.245)
MNE wage premium (%)	-0.583	-0.463 (0.794)	-0.342 (0.587)
MNE labor income	5.9033	6.5604 (1.111)	7.4696 (1.265)
MNE total profit	3.4624	3.7915 (1.095)	4.2285 (1.221)
<u>Jobs Lost</u>		1.23%	2.85%
Avg. z (%ile)		15.55	15.55
<u>Jobs Gained</u>		3.23%	7.30%
Avg. z (%ile)		66.76	66.64

Values in parentheses are relative to initial value with $g = 1$. Simulations use 500,000 draws from the ex ante distribution of productivity and exposure. The size of the domestic labor force is set to $L = 100$. Wages, employment and income correspond to production (not fixed cost) activities only.

B.2 Calibration Details for Greater Foreign Exposure

In this section, I display the results of the calibration associated with the numerical results presented in Section 4.3. As in the baseline calibration, I assume that both foreign and domestic firms share a common ex ante Pareto distribution of inverse marginal costs (γ) with shape parameter $\kappa = 2$. As before, I back out the marginal distributions of exposure so that both marginal distributions of wages are log normal with standard deviation $\sigma_w = 0.055$ (at the normalized $g_0 = 1$). The domestic exposure distribution remains as in the baseline. However, I now calibrate the mean of the foreign exposure distribution in order to generate a 50% MNE wage premium (relative to the average wage of domestic firms). Since the MNE wage premium depends upon the marginal cost cutoffs for entry, exporting, and FDI, this relative mean is added to the joint calibration of the model's other parameters. As shown in Table B.3, the calibration results in a mean of the foreign exposure distribution is 166% greater than the domestic exposure distribution.

As in the baseline calibration, I calibrate a common ex ante correlation between productivity and exposure in order to match an overall size, wage elasticity of 0.04, and back out the implies dis-

tribution of productivity conditional on exposure. Note that the greater mean of foreign exposure necessarily implies a greater unconditional mean of foreign productivity. In this case, the resulting mean of the foreign productivity distribution is 42% greater than the domestic productivity distribution.

Table B.3: Calibration Summary - Foreign Exposure

Description	Parameter	Value
Productivity, exposure corr.	ρ	0.251
Fixed domestic cost	f_d	0.987
Fixed export cost	f_x	1.992
Fixed FDI cost	f_I	5.562
Foreign market size	B'	8.065
Average exposure ratio	$\mu_{z'}/\mu_z$	2.664

Description	Target	Model	Error
MNE sales intensity	0.340	0.340	0.0%
Domestic exporter share	0.142	0.142	0.2%
Exports % of GDP	20.30	20.33	0.2%
Unemployment rate	6.800	6.813	0.2%
Size-wage elasticity	0.040	0.040	0.0%
MNE wage premium	50.00	49.88	0.2%